DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claims 26-29 and 33-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 6,311,549 to Thundat and US 6,408,496 to Maynard.

3. Regarding Claim 26, Thundat discloses a method of determining a property of a fluid using a sensing element comprising: providing a flexible element having a first end and a second end and being movable from a first configuration to a second configuration via bending of said flexible element (Thundat, flexible element 3), said flexible element comprising an actuating portion arranged to move said flexible element between said first configuration and said second configuration (Thundat, actuating portion 4), inducing movement in said flexible element between said first configuration and said second configuration by applying a heat signal to said flexible element (Thundat, column 3, lines 10-15); receiving a signal from said sensing element, said signal being indicative of the induced movement of the flexible element within the liquid (Thundat, signal receiver 8); and processing said signal to determine a value indicative of at least one property of the liquid (Thundat, column 3, lines 20-25).

4. Thundat does not explicitly disclose that the length of the flexible element from the first end to the second end being between 100μm and 1mm or the movement of the second end of the flexible element between the first and second configurations is at least 30 μm.

5. It would have been obvious to one of ordinary skill in the art to modify Thundat's device with the technique of changing the scale or adopting the techniques that allow Maynard to use a

cantilevered mass that can travel more than 30 micrometers (Maynard, column 6, lines 63-65). As to the specific dimension of 100 μm to 1mm, it would have been obvious to one having ordinary skill in the art at the time the invention was made to employ any desired dimension, without undue experimentation, to achieve the desired total mass and response characteristics desired.

6. Regarding Claim 27, Thundat discloses a method wherein said signal is processed to determine a value indicative of at least one property of a group comprising viscosity, temperature, flow rate and shear rate (Thundat, column 3, lines 20-25).

7. Regarding Claim 28, Thundat discloses a method further comprising determining a rate of change of movement of said flexible element, by monitoring a change in the received signal with time; and determining a value indicative of the viscosity of said fluid from said rate of change of movement (Thundat, column 2, lines 35-40).

8. Regarding Claim 29, Thundat discloses a method comprising determining an amplitude of movement of said flexible element from said received signal for a given applied heat signal (Thundat, column 3, lines 25-30); and determining a value indicative of the viscosity of said fluid from said amplitude (Thundat, column 5, lines 25-30).

9. Regarding Claim 33, Thundat discloses a method wherein the device comprises a plurality of flexible elements, such that the plurality of flexible elements may be used to determine a value indicative of at least one property of said fluid in a plurality of locations (Thundat, column 5, lines 67-68).

10. Regarding Claim 34, Thundat discloses a method wherein the device comprises a plurality of flexible elements, at least one of the plurality being used to cause a flow within the

fluid, and at least one of the plurality being used to determine a value indicative of at least one property of said fluid (Thundat, column 5, lines 67-68).

11. Regarding Claim 35, Thundat discloses a method further comprising holding the flexible element in at least one of said two configurations by a magnetic force (Thundat, lines 9-12).

12. Regarding Claim 36, Thundat discloses a method further comprising holding the flexible element in at least one of said two configurations by an electrostatic force (Thundat, lines 9-12).

13. Regarding Claim 37, Thundat discloses a method wherein said received signal is indicative of a maximum deflection of the flexible element, said signal being processed to determine the viscosity of the fluid (Thundat, column 3, lines 24-28). Resonance frequencies imply the maximum amplitude, which is equivalent to a maximum deflection of the flexible element. Thundat's device sends a continuous signal indicative of the deflection of the flexible element (Thundat, signal receiver 8).

14. Claims 38-40, 42-45, 50-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Daraktchiev (6,457,360) in view of Maynard (6,408,496).

15. Regarding Claim 38, Daraktchiev discloses a device comprising a body region; a flexible element having a first end and a second end, said first end being fixedly located on said body region (Daraktchiev, figure la), said flexible element being arranged to move from at least a first configuration to a second configuration via bending of said flexible element (Daraktchiev, flexible element 1); said flexible element including a laminate of at least two layers and an actuating portion arranged to move said flexible element between said first configuration and said second configuration (Daraktchiev, column 3, lines 31-35), the actuating portion being provided by at least a first layer of said laminate having a different coefficient of thermal

expansion from a second layer of said laminate such that a change in temperature of said flexible element moves the flexible element from said first configuration to said second configuration (Daraktchiev, column 1, lines 45-50); said flexible element further including a heating element for heating at least said flexible element and providing said change in temperature (Daraktchiev, heating element 3); and a movement detector arranged to detect said movement of said flexible element (Daraktchiev, movement detector 2), and to provide a signal indicative of a property of a liquid in which the flexible element is immersed (Daraktchiev, column 4, lines 17-23).

16. Daraktchiev does not explicitly disclose that the length of the flexible element from the first end to the second end being between 100μm and 1mm or the second end of the flexible element moving at least 30 micrometers between said first and second configurations.

17. Maynard discloses that a cantilevered silicon device is capable of a displacement greater that 30 micrometers (column 6, lines 63-65). As to the specific dimension of 100 μm to 1mm, it would have been obvious to one having ordinary skill in the art at the time the invention was made to employ any desired dimension, without undue experimentation, to achieve the desired total mass and response characteristics desired.

18. Applying Maynard's technique to Daraktchiev's device, or merely changing the scale of Daraktchiev's device would have yielded predictable results, as well as allowed for the claimed range of motion.

19. Regarding Claim 39, Daraktchiev discloses a device wherein said movement detector comprises a piezoresistive element located on said flexible element arranged such that the electrical resistance of the piezoresistive element changes due to movement of said flexible element (Daraktchiev, piezoresistive element 2).

20. Regarding Claim 40, Daraktchiev discloses a device further comprising latching means arranged to hold the flexible element in at least one of said two configurations.

21. Regarding Claim 42, Daraktchiev discloses a device wherein at least one of the first and second layers of said laminate comprises a polymer (Daraktchiev, column 4, lines 19-24).

22. Regarding Claim 43, Daraktchiev discloses a device wherein at least one of the first and second layers of said laminate comprises a material selected from a group consisting of polyimides, polyamides and acrylic polymers (Daraktchiev, column 4, lines 19-24). Daraktchiev is using an organic polymer as photoresist, and it is well known that organic polymers that double as photoresist are typically polyimides. Furthermore, applicant admits that use of polyimides as a material in the construction of MEMS cantilevers has been known since at least 1993 (Journal of Microelectromechanical systems, Vol. 2, No. 4, December 1993, page 147)

23. Regarding Claim 44, Daraktchiev discloses a device, wherein the second layer of said laminate comprises a metal (Daraktchiev, column 3, lines 33-36).

24. Regarding Claim 45, Daraktchiev discloses a device wherein the metal is selected from a group consisting of gold or aluminium (Daraktchiev, column 3, lines 33- 36).

25. Regarding Claim 50, Daraktchiev discloses a device wherein said piezoresistive element is located on the flexible element at a position remote from the body region (Daraktchiev, column 3, lines 40-42).

26. Regarding Claim 51, Daraktchiev discloses a device wherein said piezoresistive element is formed as a layer of the laminate of said flexible element (Daraktchiev, figure 2a, column 3, lines 40-45).

27. Claims 41,47 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Daraktchiev modified by Maynard with teachings from Thundat.

28. Daraktchiev discloses a device, but does not explicitly disclose that the device comprises a movement detector using an electromagnetic radiation source and an electromagnetic radiation detector, or that the device comprises a plurality of flexible elements, or that the flexible elements are arranged in a first and second row.

29. Thundat discloses a device wherein said movement detector comprises an electromagnetic radiation source arranged to direct radiation towards said element, and an electromagnetic radiation detector arranged to detect electromagnetic radiation at least one of: reflected from, transmitted through, refracted from or diffracted by said flexible element (Thundat, column 6, lines 1-5). Thundat further discloses the device comprises a plurality of flexible elements (Thundat, column 5, lines 67-68). Thundat further discloses the plurality of flexible elements are arranged in a first row and a second row, each row comprising at least one flexible element, the flexible elements being arranged such that the at least one flexible element of the first row extends in opposition to the at least one flexible element of the second row (Thundat, column 5, lines 57-59). It would have been obvious to one of ordinary skill in the art at the time of the invention to apply teachings from Thundat to Daraktchiev the employment of an electromagnetic radiation source and detector to detect motion/deflection of the flexible element is well known in the art at the time the inveniton was made, a well as the employment of multiple rows of flexible elements to sense physical properties in their immediate vicinity.

30. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Thundat modified by Maynard with teachings from Daraktchiev.

31. Thundat teaches a device that determines a value indicative of the temperature of the fluid (lines 37-40), but does not explicitly teach that the flexible element comprises a laminate of at least two layers, each layer having a different coefficient of thermal expansion. The use of a reference cantilever to account for temperature variation via wavelet or Fourier analysis constitutes determining some value indicative of temperature, and does not necessarily fall short of determining a temperature value.

32. Daraktchiev teaches a device wherein said actuating portion of said flexible element comprises a laminate of at least two layers, each layer having a different coefficient of thermal expansion (Daraktchiev, column 1, lines 45-50).

33. It would have been obvious to one of ordinary skill in the art at the time of the invention to use Thundat with teachings from Daraktchiev because Daraktchiev teaches a higher precision method of vibrating a cantilever than traditional external vibrators, such as piezo crystals (Daraktchiev, column 1, lines 29-35).

34. Claim 49 is rejected under 35 U.S.C. 103(a) as being unpatentable over Daraktchiev modified by Maynard and Thundat with teachings from Murilo Coutinho et al. (Coutino).

35. Daraktchiev teaches a device comprising a plurality of flexible elements, but does not explicitly teach that the flexible elements are interdigiated.

36. Coutinho teaches that the plurality of flexible elements are interdigitated (Coutinho, figure 5).

37. It would have been obvious to one of ordinary skill in the art to combine Coutinho with teachings from Daraktchiev because Coutinho teaches that a field of MEMS cantilever devices may act, or determine actions in a variety of directions on a scale larger than the devices

themselves (Coutino, page 2, lines 27-40). It is also obvious because a MEMS cantilever that is used to apply a force can just as easily be used to measure a force, as all atomic force microscopes demonstrate.

38. Claims 30 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Thundat modified by Maynard with teachings from US Patent Application 2003/0056574 to Wolfgang Drahm et al. (Drahm).

39. Thundat teaches a device that uses vibration to determine liquid characteristics at a plurality of locations (Thundat, column 5, lines 57-59), but does not explicitly disclose that it can be used to determine flow rate or shear rate.

40. Drahm teaches a device further comprising determining a change in said movement of said flexible element; and determining a value indicative of a flow rate of the fluid from said change in movement, said change in movement being due to flow of the fluid against said flexible element (Drahm, page 5, paragraph 104) and also comprising determining a value indicative of a shear rate of said fluid by determination of the flow rate at a plurality of locations within said fluid (Drahm, page 3, paragraph 71).

41. It would have been obvious to one of ordinary skill in the art at the time of the invention to combine Thundat with teachings from Drahm because Drahm teaches a vibratory viscometer that is 100 times more accurate than other vibratory viscometers (Drahm, page 1, paragraph 16).

Allowable Subject Matter

42. Claims 54-80 are allowed.

Conclusion

43. Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Fitzgerald whose telephone number is (571) 272-2843. The examiner can normally be reached on Monday-Friday from 7:00 AM to 3:30 PM. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hezron Williams, can be reached on (571) 272-2208. The central fax phone number for the organization where this application or proceeding is assigned is 571-273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/John Fitzgerald/
Primary Examiner, Art Unit 2856
3/29/10